BURBANK CANYON G-E-M RESOURCES AREA

(GRA NO. NV-10)

TECHNICAL REPORT

(WSA NV 030-525A)

Contract YA-554-RFP2-1054

Prepared By

Great Basin GEM Joint Venture
251 Ralston Street
Reno, Nevada 89503

For

Bureau of Land Management
Denver Service Center
Building 50, Mailroom
Denver Federal Center
Denver, Colorado 80225

Final Report

May 6, 1983

TABLE OF CONTENTS

Table of Contents cont.

Table of Contents cont.

Page

LIST OF ILLUSTRATIONS

ATTACHMENTS
(At End of Report)

EXECUTIVE SUMMARY

The Burbank Canyon Geology-Energy-Minerals (GEM) Resource Area (GRA) is a few miles north of Wellington; the town is in Lyon County, Nevada and the GRA lies partly in that county and partly in Douglas County. There is one Wilderness Study Area (WSA), NV 030-525A, which is in Douglas County.

The rocks in the GRA include volcanic and sedimentary rocks about 200 million years old which were intruded and somewhat metamorphosed by extensive granitic bodies about 100 million years ago. Overlying these in some places are volcanic rocks and sediments a few million years old or younger. Mineralization in the GRA is related to the old intrusive rocks, but may be in those rocks or in the still older volcanic and sedimentary rocks.

There is one mining district in the GRA, the Red Canyon district, which has produced somewhat more than $100,000 (about $1 million at present-day prices) in gold and silver with minor lead, zinc and antimony. Antimony and zinc are strategic and critical metals, and silver and lead are strategic metals.

The WSA lies in the middle of the east end of the district. Three mines with known production, including the largest producer in the district, are within the WSA near its western edge. Two productive mines lie just north of the WSA, and there are geochemical anomalies just outside and within it. A prospect lies at the east edge of the WSA, and two patented claims lie in a cherrystem inside the south edge of the WSA.

Besides the patented claims just mentioned, there is a patented claim at the southeast corner of the WSA, either inside or outside the WSA. Other patented claims in the district are well outside the WSA. There are a great many unpatented claims in the northwest corner of the GRA, well away from the WSA. A cluster of unpatented claims in the south center of the GRA extends into the WSA in the vicinity of the first three mines mentioned above. A small scattering of claims along the north edge of the WSA lie partly inside of it and partly outside. Another small scattering of unpatented claims lies near the patented claims on the cherry-stem at the south edge. There are no oil and gas or geothermal leases in the GRA.

Most of the west end of WSA NV 030-525A is classified as highly favorable for metallic minerals, with a high level of confidence, while the north edge is classified as highly favorable with a moderate level of confidence. Most of the remainder of the WSA is classified as having moderate favorability for metallic minerals with a low level of confidence, but a small area has low favorability with a low level of confidence. The entire WSA is classified as having low favorability with a low confidence for nonmetallic minerals and uranium and thorium. There is no indication of favorability for oil and gas with a high level of

confidence. Geothermal resources range from a high favorability and high confidence to a low favorability and very low confidence level. The WSA has no known favorability for sodium and potassium, or for coal or oil shale, with a high level of confidence.

Examination of known old mines and prospects that appear to be within the WSA is recommended. Reconnaissance geological mapping of the entire WSA is recommended, with geochemical sampling if altered areas are found.

I. INTRODUCTION

The Burbank Canyon G-E-M Resources Area (GRA No. NV-10) contains approximately 110,000 acres (430 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Burbank Canyon	NV 030-525A

The GRA is located in Nevada in the Bureau of Land Management's (BLM) Walker Resource Area, Carson City district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 38°50' north latitude, 119°30' west longitude and includes the following townships:

T 12 N, R 21-23 E   T 11 N, R 21-23 E

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

15-minute:

Mt. Siegel   Wellington

The nearest town is Wellington which is about one mile south of the southern border of the GRA along State Route 22. Access to the area is via State Route 22 to the southeast, State Route 3 to the south, and U. S. Highway 395 to the west and south. Access within the area is unimproved light duty and dirt roads scattered throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

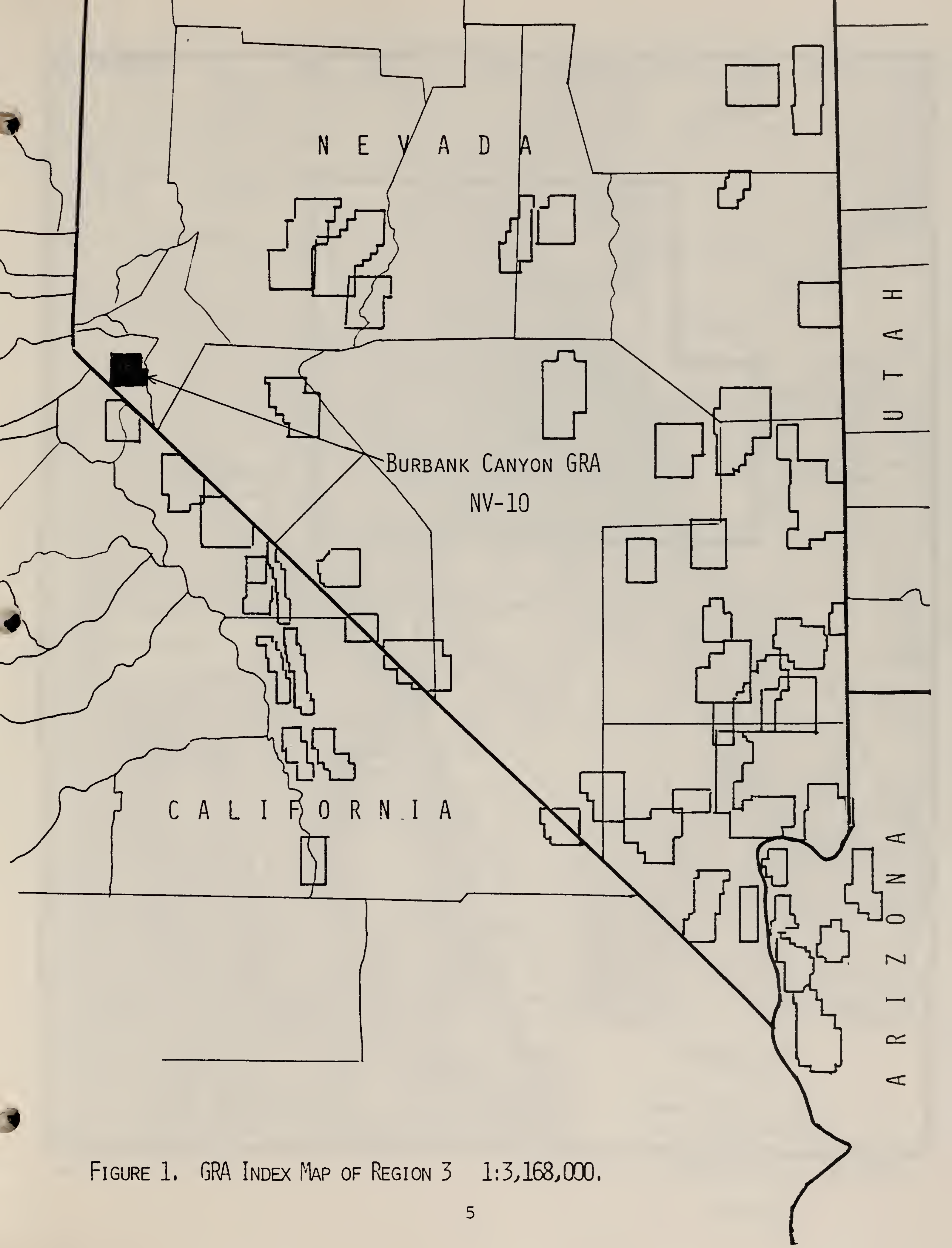
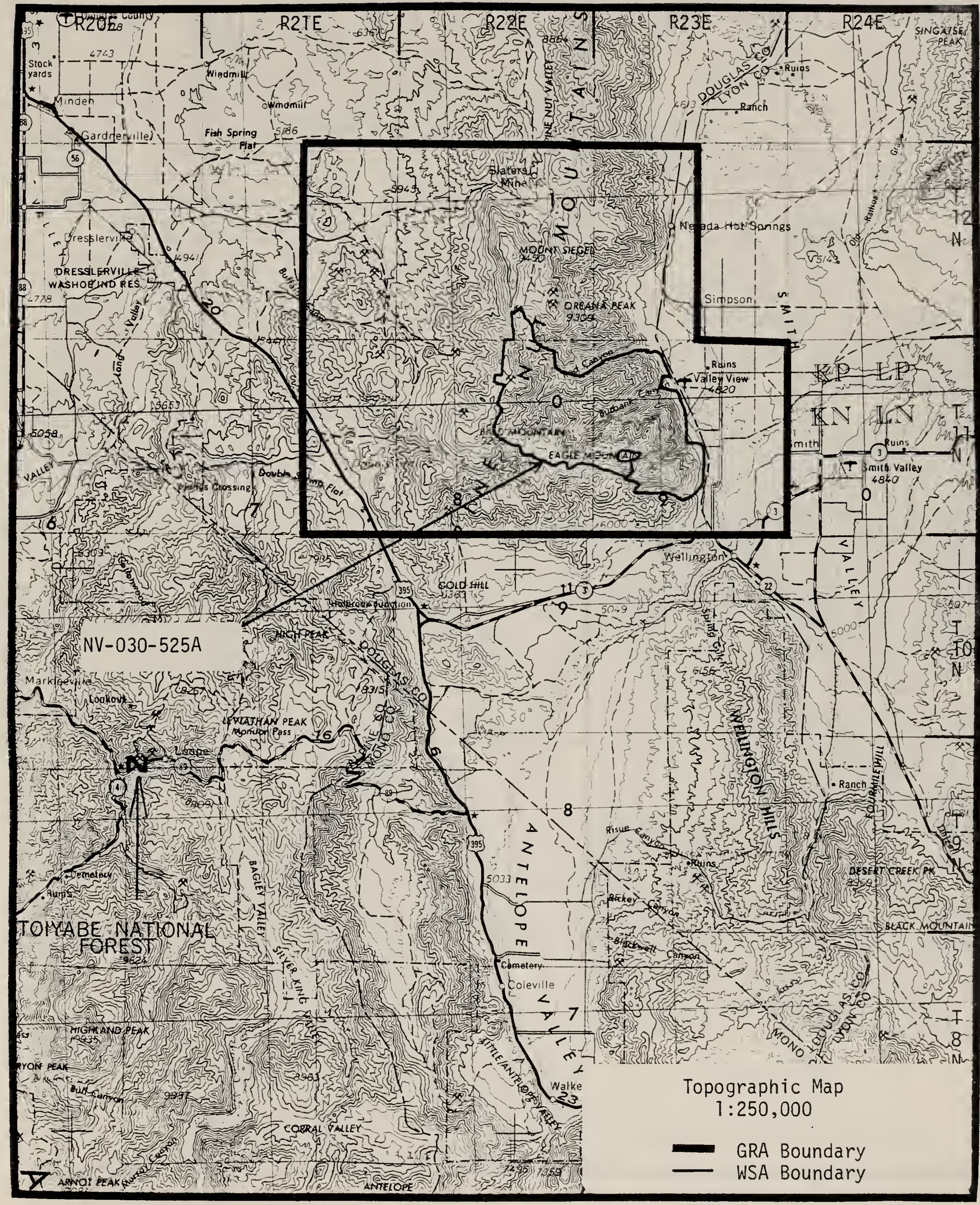


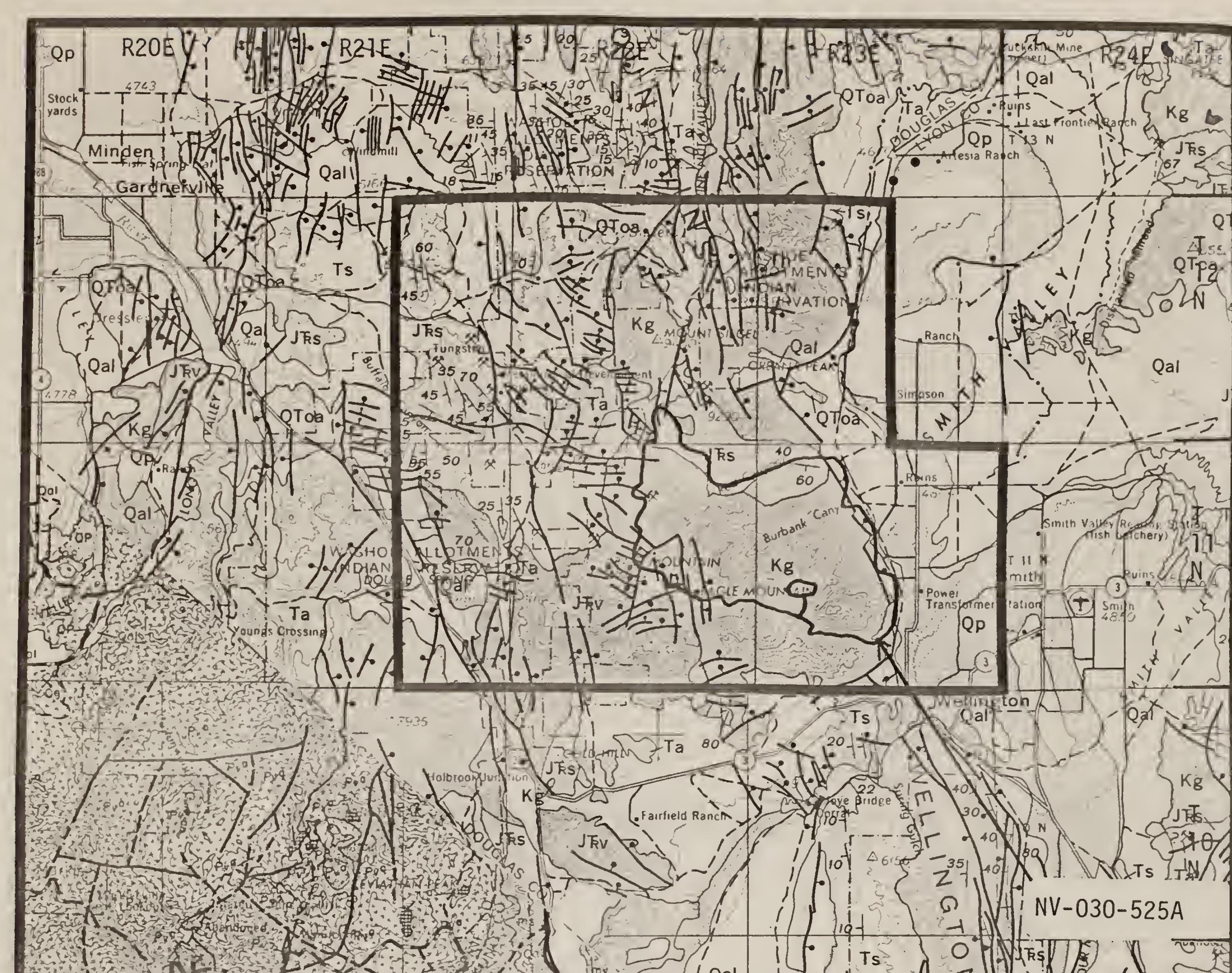
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Walker Lake Sheet

Burbank Canyon GRA NA-10

Figure 2



Koenig (1963); Moore (1969)

Burbank Canyon GRA NV-10

Figure 3

EXPLANATION

Pleistocene and Recent — QUATERNARY

Qal Qp

Alluvium

Qal, mainly alluvial fan gravel, stream-laid gravel, sand, and silt, some talus material, and dune sand
Qp, fine sand, silt, and clay of river flood plains, and playa clay and sand

TERTIARY AND QUATERNARY

QToa

Older alluvium

Predominantly fanglomerate and pediment gravel, but includes terrace gravel and late Pleistocene lake beds. Pediment gravel commonly caps poorly consolidated Tertiary sediments

Pliocene Pleistocene — TERTIARY OR QUATERNARY

QTb

Basalt

[illegible] with interbeds of scoriaceous [illegible] breccia and [illegible] sediments. Includes Mc[illegible]llan Peak and [illegible] Formations. In part younger than older alluvium

Miocene and Pliocene — TERTIARY

Ta

Andesitic rocks

Flow breccias, lava flows, and agglomerate with interbedded sediments. Locally includes basaltic and rhyolitic rocks. Includes Alta and Kate Peak Formations, and Chloropagus Formation of Axelrod (1956)

Ts

Sedimentary rocks

Lacustrine and fluviatile sediments. Sandstone, mudstone, shale, marl, diatomite, limestone, and calcareous tufa. Interbedded tuffaceous rocks, lava flows, and breccia. Includes Truckee Formation and Aldrich Station, Coal Valley, and Morgan Ranch Formations of Axelrod (1956)

Tr

Rhyolite

Rhyolitic tuffs, flows, and intrusions. Relation to Hartford Hill Rhyolite Tuff is uncertain

Miocene

Th

Hartford Hill Rhyolite Tuff

Widespread biotite rhyolite pumice tuff-breccia and welded tuff. Welded, black, glassy basal layer is locally present

CRETACEOUS

Kgp
Kpg
Kg

Granitic rocks

Kgp, *granite porphyry*
Kpg, *porphyritic quartz monzonite*
Kg, *undivided, nonporphyritic quartz monzonite, granodiorite, and hybrid mafic rocks. In general, porphyritic quartz monzonite is younger than undivided granitic rocks and older than granite porphyry*

TRIASSIC AND JURASSIC

JTRs

Metasedimentary rocks

Shale, slate, tuffaceous siltstone, sandstone, and graywacke largely derived from volcanic rocks. Interbeds of conglomerate, limy shale, limestone, dolomite, and gypsum

JTRv

Metavolcanic rocks

Andesite breccias, tuffs, and flows; [illegible], and rhyolite; with interbedded volcanic-derived sedimentary rocks and limestones. Metamorphosed to [illegible] higher metamorphic facies

EXPLANATION

SEDIMENTARY AND METASEDIMENTARY ROCKS

CENOZOIC

QUATERNARY

Recent

- Qs — Dune sand
- Qal — Alluvium
- Qsc — Stream channel deposits (GREAT VALLEY)
- Qf — Fan deposits (GREAT VALLEY)
- Qb — Basin deposits (GREAT VALLEY)
- Qst — Salt deposits
- Ql — Quaternary lake deposits
- Qg — Glacial deposits
- Qt — Quaternary nonmarine terrace deposits

Pleistocene

- Qm — Pleistocene marine and marine terrace deposits
- Qc — Pleistocene nonmarine
- QP — Plio-Pleistocene nonmarine

TERTIARY

Pliocene

- Pc — Undivided Pliocene nonmarine
- Puc — Upper Pliocene nonmarine
- Pu — Upper Pliocene marine
- Pmlc — Middle and/or lower Pliocene nonmarine
- Pml — Middle and/or lower Pliocene marine

Miocene

- Mc — Undivided Miocene nonmarine
- Muc — Upper Miocene nonmarine
- Mu — Upper Miocene marine
- Mmc — Middle Miocene nonmarine
- Mm — Middle Miocene marine
- Ml — Lower Miocene marine

Oligocene

- Φc — Oligocene nonmarine
- Φ — Oligocene marine

Eocene

- Ec — Eocene nonmarine
- E — Eocene marine

Paleocene

- Epc — Paleocene nonmarine
- Ep — Paleocene marine

IGNEOUS AND META-IGNEOUS ROCKS

- Qrv — Recent volcanic: Qrv^r —rhyolite; Qrv^a —andesite; Qrv^b —basalt; Qrv^p —pyroclastic rocks
- Qpv — Pleistocene volcanic: Qpv^r —rhyolite; Qpv^a —andesite; Qpv^b —basalt; Qpv^p —pyroclastic rocks
- (cinder cone symbol) — Quaternary and/or Pliocene cinder cones
- Pv — Pliocene volcanic: Pv^r —rhyolite; Pv^a —andesite; Pv^b —basalt; Pv^p —pyroclastic rocks
- Mv — Miocene volcanic: Mv^r —rhyolite; Mv^a —andesite; Mv^b —basalt; Mv^p —pyroclastic rocks
- Φv — Oligocene volcanic: $Φv^r$ —rhyolite; $Φv^a$ —andesite; $Φv^b$ —basalt; $Φv^p$ —pyroclastic rocks
- Ev — Eocene volcanic: Ev^r —rhyolite; Ev^a —andesite; Ev^b —basalt; Ev^p —pyroclastic rocks

EXPLANATION CONT.

PALEOCENE

Ep — Paleocene marine

UNDIVIDED

QT — Cenozoic nonmarine

Tc — Tertiary nonmarine

Tl — Tertiary lake deposits

Tm — Tertiary marine

QTv — Cenozoic volcanic: QTvr—rhyolite; QTva—andesite: QTvb—basalt; QTvp—pyroclastic rocks

Tgr — Tertiary granitic rocks

Ti — Tertiary intrusive (hypabyssal) rocks: Tir—rhyolite; Tia—andesite; Tib—basalt

Tv — Tertiary volcanic: Tvr—rhyolite; Tva—andesite; Tvb—basalt; Tvp—pyroclastic rocks

MESOZOIC

CRETACEOUS

K — Undivided Cretaceous marine

Ku — Upper Cretaceous marine

Kl — Lower Cretaceous marine

JURASSIC

Jk — Knoxville Formation

Ju — Upper Jurassic marine

Jml — Middle and/or Lower Jurassic marine

TRIASSIC

Tr — Triassic marine

KJf — Franciscan Formation

KJfv — Franciscan volcanic and metavolcanic rocks

gr — Mesozoic granitic rocks: gra-granite and adamellite; grg-granodiorite; grt-tonalite and diorite

bi — Mesozoic basic intrusive rocks

ub — Mesozoic ultrabasic intrusive rocks

JTrv — Jura-Trias metavolcanic rocks

UNDIVIDED

m / ls — Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)

ms — Pre-Cretaceous metasedimentary rocks

Pz / ls — Paleozoic marine (ls = limestone or dolomite)

mv — Pre-Cretaceous metavolcanic rocks

gr-m — Pre-Cenozoic granitic and metamorphic rocks

Pzv — Paleozoic metavolcanic rocks

PALEOZOIC

PERMIAN

P — Permian marine

Pv — Permian metavolcanic rocks

CARBONIFEROUS

C — Undivided Carboniferous marine

Cv — Carboniferous metavolcanic rocks

CP — Pennsylvanian marine

CM — Mississippian marine

DEVONIAN

D — Devonian marine

Dv — Devonian metavolcanic rocks

Dv? — Devonian and pre-Devonian? metavolcanic rocks

SILURIAN

S — Silurian marine

pSs — Pre-Silurian metasedimentary rocks

pS — Pre-Silurian metamorphic rocks

pSv — Pre-Silurian metavolcanic rocks

ORDOVICIAN

O — Ordovician marine

CAMBRIAN

Є — Cambrian marine

Є? — Cambrian – Precambrian marine

pЄc — Precambrian igneous and metamorphic rock complex

PRECAMBRIAN

pЄ — Undivided Precambrian metamorphic rocks; pЄg = gneiss, pЄs = schist

pЄgr — Undivided Precambrian granitic rocks

lpЄ — Later Precambrian sedimentary and metamorphic rocks

pЄan — Precambrian anorthosite

epЄ — Earlier Precambrian metamorphic rocks

II. GEOLOGY

The Burbank Canyon GRA is in the Basin and Range province in Douglas and Lyon Counties, Nevada. The study area includes the southernmost portion of the Pine Nut Mountains, a broad west tilted complex fault block. WSA NV 030-525A is in Douglas County and covers the Eagle Mountain area in which most of the rocks are Cretaceous quartz monzonite and granodiorite with some Triassic-Jurassic sediments.

Numerous northerly-trending Basin and Range type normal faults transect the Jurassic-Triassic metavolcanic and metasedimentary rock units that cover the western part of the GRA. The eastern flank of the range is a steep escarpment formed by a fault with over 3,200 feet of displacement.

1. PHYSIOGRAPHY

The Burbank Canyon GRA lies in the Basin and Range province in Douglas and Lyon Counties, Nevada. The study area includes a southern portion of the Pine Nut Mountains which is the central segment of a longer mountain range that can be considered a single structural unit (Moore, 1969).

Rock units in the GRA consist of Triassic and Jurassic metavolcanics and metasediments that have been intruded by Cretaceous quartz monzonite and granodiorite. Late Tertiary volcanics and laccustrine and fluvatile sediments overlap the older rocks in the western half of the study area. Numerous normal faults transect the rock units and generally trend north-northwest.

The topography is rugged, with elevations along the crest of the range averaging about 8,900 feet and peaks reach 9,450 feet at Mount Siegel. The floors of the valleys east and west of the range area are at about 4,300 feet. Drainage of the area is internal with streams on the western flank discharging into the Carson River, which terminates at the Lahontan Reservoir. The eastern flank drains into the west Walker River which ends at Walker Lake.

2. ROCK UNITS

The oldest rock unit in the GRA is a series of metamorphosed Triassic-Jurassic formations as much as 20,000 feet thick. The lower half of the unit is mostly sedimentary rocks, including thick limestones, carbonaceous and pyritic siltstones, minor conglomerate, and some volcanic units. Above this is a series of volcanic formations ranging in composition from rhyolite to andesite with a few relatively thin sedimentary layers. The uppermost part of the unit is 10,000 feet or more of tuff with minor intercalated sandstone,

calcareous fresh-water tuff, and marine limestone (Noble, 1962). In the northern part of WSA NV 030-525A there is a band of the sedimentary or lower part of the unit, while in the southern part there are small areas of the volcanic unit (Moore, 1969).

The Triassic-Jurassic units were metamorphosed to greenschist facies before or during the emplacement of quartz monzonite and granodiorite intrusives in the Cretaceous. These intrusives are part of the Sierra Nevada batholith, the main body of which is exposed a few miles to the west. Nearly all of the WSA is underlain by these intrusive rocks (Moore, 1969).

Dixon (1971) mapped in detail an area of about three square miles at the north-central edge of the WSA, separating the Triassic-Jurassic sediments into several local units and also distinguishing several different kinds of intrusive rocks -- both major bodies and dikes. Undoubtedly the rest of the area is equally complex if its geology were to be mapped in similar detail.

After a very long period of erosion, in the Eocene or Oligocene the Hartford Hill Rhyolite Tuff was deposited in the GRA and in a large region to the north and east. Only a small remnant of the Hartford Hill remains in the GRA, a long narrow band several miles north of the WSA.

In Middle Tertiary time a series of andesite flows, breccias and agglomerates, with local interbedded sediments, was deposited. This heterogeneous unit as shown on the county map by Moore (1969) includes the Alta, Kate Peak and Chlorpagus Formations of Axelrod (1956). A small area at the south edge of the WSA is underlain by these andesites (Moore, 1969).

At some time during the Tertiary extensive sediments were deposited in a local basin to a thickness believed to be greater than 1,000 feet. The age of these sediments has not been determined directly, but in comparison with sediments in the region that were deposited in other basins, they may be Pliocene. The unit is seen within the GRA only in the northwestern corner and at the southeastern edge, and it is not in the WSA (Moore, 1969).

Quaternary-Tertiary gravels cover extensive areas in the region and in the northern part of the GRA, but not in the WSA.

3. STRUCTURAL GEOLOGY AND TECTONICS

The oldest structural features in the Burbank Canyon GRA are found in the pre-Tertiary rocks that were folded, sheared and recrystallized partly as a result of the intrusion of the Sierran granitic complex. Much of the pre-granitic structure

has been obscured by metamorphism, and was not mapped in detail by Moore (1969). In general, the bedding strikes a little west of north and dips steeply.

Late Tertiary normal faulting and tilting responsible for the present day topography are the most prominent structures in the GRA. The Pine Nut Mountains are a broad complex block, sharply upfaulted on the east and tilted west. The Pine Nut Mountains comprise several orographic blocks separated by north-trending normal faults downthrown on the east. As a result of these blocks being tilted individually, the range has several north-trending crests, with high valleys such as Pine Nut valley in between. The eastern range front is a steep escarpment with an estimated displacement of at least 3,200 feet (Moore, 1969). The western slope is cut by swarms of northwesterly-trending normal faults of small displacement. These faults are Late Quaternary in age and have displacements from a few feet to about 20 feet. Within the mountains are swarms of west to west-northwest-trending faults that also affect both the Tertiary-Quaternary gravels and the older rocks. Some of these are present in the GRA and the WSA.

At its southern end the Pine Nut range is cut by a northeast-trending normal fault downthrown on the south. The vertical displacement of this fault is estimated to be about 3,500 feet (Moore, 1969).

4. PALEONTOLOGY

Pliocene and (?)Miocene mammalian fossils have been collected from lacustrine units correlative with strata exposed in the northwestern part of the Burbank Canyon GRA. However, no fossils are known to occur within the GRA boundary, although some non-marine mollusks occur in similar strata just north of the GRA and also in Smith Valley, southeast of the study area (J.R. Firby, personal field investigations).

5. HISTORICAL GEOLOGY

During the Mesozoic a period of deformation occurred preceding and accompanying the emplacement of Cretaceous granitic rocks related to the Sierra Nevada Batholith. Previously deposited Triassic-Jurassic sediments and volcanics were metamorphosed, warped and folded.

Volcanism in early Tertiary time deposited the Hartford Hill Rhyolite Tuff. Mid-Tertiary andesites were deposited in the area, and perhaps coevally but probably later during the Pliocene, lacustrine sediments were deposited in a local basin.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

WSA NV 030-525A occupies essentially the middle of the eastern half of the Red Canyon mining district. It is literally surrounded by mines and prospects. The district is credited with a little more than $100,000 (about $1 million at 1980s prices) production (Moore, 1969), most of it in gold and silver and more than half of it from the Longfellow mine (Dixon, 1971), which is inside the WSA (Locality #1 on the Metallic Mineral Occurrence and Land Classification Map). One mile south of the Longfellow is the property called the Washoe claims (#2) by Hill (1915), which is probably the Premier mine shown as a cluster of adit and prospect symbols on the Mt. Siegel 15-minute topographic quadrangle map. According to Hill's comment this was probably a gold mine, but its production is unknown. Most of the remaining production came from the Winter's silver-lead mine (#3) a couple of miles north of the WSA. The Lucky Bill mine (#4) south of the Winters and just outside the WSA, has known production of 23 tons of high-grade silver-lead-zinc ore.

MILS data places the San Juan-El Capitan productive gold mine in Sec. 11, T 11 N, R 23 E, about a mile east of the Premier and well within the WSA.

For several miles west of the WSA there are other prospects and occurrences of mineralization, most of them gold. Only the Veta Grande property, about seven miles west of the WSA, is known to have produced metal -- silver in this case (Arthur Baker III, personal communication).

2. Known Prospects, Mineral Occurrences and Minerlaized Areas

In a small reentrant in the eastern boundary of the WSA at the mouth of Red Canyon is the Red Canyon property (#5), a contact metamorphic copper deposit (Hill, 1915). It may have made some production in the very early 1900s but there is no record of production.

In a cherry-stemmed area half a mile within the southern boundary of the WSA are patented claims that apparently are the Mountain Gold claims similarly located on Hill's (1915) map.

Geochemical work by Dixon (1971, see copper-zinc geochemical map in GRA file) shows anomalous traces of the elements at one point (#7) inside the WSA and at others (#8 and #9) just north of the WSA.

3. Mining Claims

There are patented claims in the cherry-stemmed area mentioned above that was probably originally the Mountain Gold property, and a patented claim two miles northeast of these may be either inside or outside the WSA boundary. There are patented claims at the Winter mine and northeast of it, and at the west edge of the GRA. All of these are well outside the WSA.

There are unpatented placer claims about five miles north of the WSA in the vicinity of the Slater placer mine. There are a great many unpatented lode claims in the northwest part of the GRA, well removed from the WSA. In the south-central part of the WSA there are numerous unpatented claims, some of which, in the vicinity of the Longfellow and Premier mines, are probably within the WSA boundary.

There are unpatented claims close to the patented claims in the cherry-stem in the south side of the WSA. Along the north side of the WSA are scattered unpatented claims, some within the WSA and some outside it. These are in the vicinity of the Lucky Bill mine and Dixon's (1971) geochemical anomalies.

4. Mineral Deposit Types

Hill (1915) distinguishes four types of mineral occurrences in the Red Canyon district: quartz veins in the intrusive rocks, contact metamorphic deposits, replacement lodes in Triassic sediments, and deposits in "supposed Tertiary andesites".

The Longfellow mine and probably the Premier and Mountain Gold mines are quartz veins in the intrusive rocks. For the most part the veins are narrow and pockety, and the early-day mines were able to treat only their oxidized portions. At least at the Longfellow, the veins strike east.

The Red Canyon property has pyrite, phyrrhotite and chalcopyrite in limestone that has been altered to epidote, quartz and calcite. A somewhat similar contact metamorphic deposit is near the Winter mine.

The Winter mine is described by Hill (1915) as vein-like replacements of argillite, the vein material being quartz with argentiferous galena and stibnite. The Lucky Bill has small pockets of argentiferous galena and stibnite along fractures in quartzite according to Hill (1915). Dixon (1971), however, concludes that the so-called quartzite is actually felsite, a fine-grained intrusive

rock, and notes that much of the felsite contains disseminated sulfides. He speculates that at least some of the sulfides are parts of the original magma.

The deposits in supposed Tertiary andesites plot as being in Triassic-Jurassic volcanic rocks on Moore's (1969) map. The mineralization evidently is in fractured zones in the volcanics, mostly with little or no clear-cut quartz veining, but rather along fractures in altered rock. Silicified zones are mentioned at two of the properties (Hill, 1915).

The very widespread mineralization related to Mesozoic intrusives, though mostly in small deposits, suggests there is potential for much larger deposits that might be found. Porphyry copper or porphyry molybdenum deposits seem most likely, but there is also a possibility for major tungsten mineralization in contact metamorphic deposits.

5. Mineral Economics

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

The major uses of silver are in photographic film, sterlingware, and increasingly in electrical contacts and conductors. It is also widely used for storage of wealth in the form of jewelry, "coins" or bullion. Like gold it is commonly measured in troy ounces which weigh 31.1 grams, twelve of which make one troy pound. World production is about 350 million ounces per year, of which the United States produces about one-tenth, while it uses more than one-third of world production. About two-thirds

of all silver is produced as a by-product in the mining of other metals, so the supply cannot readily adjust to demand. It is a strategic metal. Demand is expected to increase in the next decades because of growing industrial use. At the end of 1982 the price of silver was $11.70 per ounce.

The largest use for copper is in electrical equipment and supplies and in smaller-gauge wire where its electrical conductivity is essential. Large quantities are also used in applications where its corrosion resistance is important -- in housing, brass and bronze, sea-water corrosion resistant alloys and others. It is used also in ammunition, many chemicals, and in applications where its conductivity of heat is important. World production is about 7.5 million metric tons annually, of which the United States produces about 1.5 million tons, nearly sufficient to satisfy domestic demand. Copper is a strategic metal. There are large reserves of copper ore in the world, and the United States has greater reserves and greater resources than any other country. United States demand is expected to nearly double by the year 2000, but reserves are thought to be sufficient to meet the demand. However, environmental problems of smelting copper may hinder production, and in times of low prices foreign producers tend to maintain full production for political reasons, while domestic produers tend to restrict production for economic reasons. These pressures on the United States copper industry weaken its competitive capability on the world market. At the end of 1982 the price of copper was 73 cents per pound.

The largest use for lead is in electrical storage batteries, the second being as a gasoline antiknock additive. It has many other uses, however, including radiation shielding, solders, numerous chemical applications and in construction. About four million metric tons of lead are produced in the world annually. The United States produces about half a million tons per year, and recovers about the same amount from scrap -- much of it through the recycling of old batteries. It imports about one-quarter of a million tons. Lead is classified as a strategic mineral. Demand is projected to increase somewhat in the next couple of decades, but environmental concerns will limit the increase. The United States has large ore reserves that are expected to last well beyond the end of this century at current production rates even without major new discoveries. At the end of 1982 the price was about 22 cents per pound.

About 70 percent of molybdenum is used in alloy steels where it improves hardenability and toughness, as well as resistance to corrosion and abrasion. Some is used by itself as a refractory metal, and the remainder is used in chemical and other nonmetallurgical applications. The

United States uses about 70 million pounds annually, while producing more than 125 million pounds; the rest of the world produces only about 90 million pounds, so the United States is by far the worlds largest supplier of molybdenum. For many years the Climax deposit in Colorado alone supplied most of the world's molybdenum, with the remainder coming mostly as a by-product of large-scale copper mining. In recent years several large deposits have been found in the United States in which molybdenum is the principal metal, and these, with by-product production, are expected to be ample to meet United States demand well through the year 2000. In late 1982 the price of molybdenum in the form of molybdenite, molybdenum sulfide -- the mineral that is the usual F.O.B. mine product -- was $7.90 per pound.

More than half of all tungsten used is in the form of tungsten carbide, a hard and durable material used in cutting tools, wear-resistant surfaces and hard-faced welding rods. Lesser quantities are used in alloy steels, in light bulb filaments, and in chemicals. World production of tungsten is nearly 100 million pounds annually, of which the United States produces somewhat more than six million pounds, while using more than 23 million pounds. The shortfall is imported from Canada, Bolivia, Thailand and Mainland China, as well as other countries. Tungsten is a strategic and critical metal. United States demand is projected to about double by the year 2000, and most of the additional supply will probably be imported, because large reserves are in countries in which profitability is not a factor -- they need foreign exchange, and therefore sell at a price that few domestic mines can match. Tungsten prices F.O.B. mine are quoted for "short ton units", which are the equivalent of 20 pounds of contained tungsten. At the end of 1982 the price of tungsten was about $80 per short ton unit.

All of the known metallic mineral deposits in the Red Canyon district are narrow and small, though locally they are high grade. It is possible that individuals or very small organizations might mine them profitably if they were found virgin today, but historically there is little to interest major companies in such veins. The abundance of small deposits, however, is likely to attract the attention of companies interested in large deposits that may be present in such a widely-mineralized area.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

No nonmetallic mineral deposits are known in the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known nonmetallic mineral prospects, occurrences or mineralized areas in the GRA, other than the general potential that any mineral material has to become an economic nonmetallic mineral resource if a market can be found that capitalizes on the material's physical or chemical characteristics.

3. Mining Claims, Leases and Material Sites

No mining claims in the GRA can be identified as having been located for nonmetallic minerals. There are no mineral leases or material sites in the GRA.

4. Mineral Deposit Types

There are no known nonmetallic mineral deposits to describe.

5. Mineral Economics

There are no known nonmetallic minerals for which the economics can be considered.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits in the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Radioactive occurrences are indicated on the Uranium Land Classification and Mineral Occurrence Map included at the back of the report.

There is one radioactive occurrence in the GRA, just south of the WSA, at the Mountain View group (11 claims in Sec. 31(?) T 11 N, R 23 E), where radioactivity is associated with an iron-stained fracture in granitic rocks (Garside, 1973).

Two other occurrences are present south of the GRA. These are located at the Triangle group (Sec. 12(?), T 10 N, R 22 E) where radioactivity is associated with an altered area in a metaconglomerate, and at the Hi-Boy claims (Secs. 9(?), 16(?), T 9 N, R 23 E) where radioactivity is

associated with iron-stained faults in Tertiary lake beds (Garside, 1973).

3. Mining Claims

The only known uranium or thorium claims or leases in the GRA are those described above. These claims have probably lapsed.

4. Mineral Deposit Types

Uranium and thorium deposit types cannot be discussed due to the lack of deposits of these elements in the GRA or WSA.

5. Mineral Economics

Uranium and thorium appear to be of little economic value in the GRA or WSA due to the lack of deposits of these elements.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Thorium is used in the manufacture of incandescent gas mantles, welding rods, refractories, as fuel for nuclear power reactors and as an alloying agent. The principal source of thorium is monazite which is recovered as a by-

product of titanium, zirconium and rare earth recovery from beach sands. Although monazite is produced from Florida beach sands, thorium products are not produced from monazite in the United States. Consequently, thorium products used in the United States come from imports, primarily from France and Canada, and industry and government stocks. Estimated United States consumption of thorium in 1980 was 33 tons, most of which was used in incandescent lamp mantles and refractories (Kirk, 1980b). Use of thorium as nuclear fuel is relatively small at present, because only two commercial thorium-fueled reactors are in operation. Annual United States demand for thorium is projected at 155 tons by 2000 (Kirk, 1980a). Most of this growth is forecast to occur in nuclear power reactor usage, assuming that six to ten thorium-fueled reactors are on line by that time. The United States and the rest of the world are in a favorable position with regard to adequacy of thorium reserves. The United States has reserves estimated at 218,000 tons of ThO_2 in stream and beach placers, veins and carbonatite deposits (Kirk, 1982); and probable cumulative demand in the United States as of 2000 is estimated at only 1,800 tons (Kirk, 1980b). The price of thorium oxide at the end of 1981 was $16.45 per pound.

Oil and Gas Resources

There are no known oil and gas deposits or oil seeps, nor have there been any exploration wells drilled in the GRA or the bordering areas.

There are no Federal oil and gas leases in the GRA or vicinity. No serious exploration for petroleum has ever been done in this part of the Basin and Range province due to the absence of source rocks.

Geothermal Resources

1. Known Geothermal Deposits

Along the western edge of Smith Valley there are numerous thermal deposits amenable to direct use. There are numerous wells and springs in the Artesia Lake Area (Locality #1 on the Geothermal Mineral Occurrence and classification Map) with temperatures of 70° to 82°F; Hind's (Nevada) Hot Springs (#2) with waters of 142° to 144°F, two wells (#3) with 117°F water. Hind's Hot Springs is in the GRA. About two miles west of the GRA in the Pine Nut Mountains there is 70°F water at Doud Spring (#4) (Garside and Schilling, 1979).

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

There are no other recorded prospects or thermal occurrences in the area. The immediate region is a known thermal area where additional shallow drilling is very likely to encounter extensions of the known thermal areas, and possibly new areas.

3. Geothermal Leases

There are no geothermal leases in the GRA or the region surrounding it.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam deposits which occur in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir, as well as the end use, determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially

for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year-round mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and crystallization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean the expenditure of no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in the GRA. There is no reason to expect resources of coal, oil shale or tar sands.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

Silver, copper, lead and tungsten are strategic metals. Zinc and antimony are strategic and critical metals. All six of these metals occur in or very close to WSA NV 030-525A, and some of them have been produced from mines.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

Moore's (1969) map provides generalized geology of the WSA, distinguishing only between Cretaceous granitic rocks and Jurassic/Triassic metasedimentary rocks. Dixon's (1971) work in a very small area along the contact of the two demonstrates that both units can be divided into at least several subunits and their relationships can be complex. There is a substantial amount of information available about mineralization in the form of notes concerning a dozen or more old mines and prospects, presented by several authors, but except in the limited area of Dixon's (1971) work no information on alteration. Overall, the quantity of geological data available is poor, though its quality is good while the quantity and quality of information pertaining to mineralization is good except for the lack of data on alteration. The overall level of confidence in the data is high.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside the WSA has been used in establishing a classification area within the WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE MINERALS

a. Metallic Minerals

WSA NV 030-525A

M1-4D. This land classification area covers part of the western end of the WSA. The rock exposed in it is all granitic intrusive. Its northern, western and southern boundaries are the contacts with the intruded rocks and the eastern boundary is arbitrarily drawn. In the areas are the Longfellow, Premier and San Juan-El Capitan productive gold mines and one of Dixon's (1971) geochemical anomalies. These are the reasons for the classification as highly favorable for metallic minerals veins, and the high level of confidence in the classification.

M2-3B. This land classification area covers most of the remainder of the WSA. It is underlain by the same intrusive rocks, and the northern boundary and part of the western boundary are the contacts with the intruded rocks. The remainder of the western boundary is the arbitrarily drawn boundary of M1-4D. The eastern boundary is the edge of alluvium at the edge of the WSA, and the southern boundary lies somewhere south of the WSA and has not been drawn. The similarity of the intrusive rock in this classification area to that in the productive M1-4D, the presence of mines and prospects to the north and west, and the presence of gold prospects at the Mountain Gold property in the WSA and in the classification area, are the reasons for the moderate favorability and low level of confidence.

M3-4C. This classification area covers part of the northern edge of the WSA and extends northward and westward outside of the WSA. In the classification area Triassic-Jurassic marine sediments are mapped, and these rocks are hosts for the silver-lead-zinc-antimony Winters and Lucky Bill mines. The presence of the mines is the reason for the high favorability classification, while the mines themselves are at some distance from the WSA, which is the reason for the only moderate level of confidence in the classification. Silver and lead are strategic metals, and antimony and zinc are strategic and critical metals.

M4-2A. This classification area covers a small part of the southwest corner of the WSA. Triassic-Jurassic volcanic rocks crop out in it (and in part are covered by Tertiary Hartford Hill Formation) such as are hosts to poorly-defined gold lodes in the western part of the Red Canyon district. The presence and known favorability of these rocks are the reason for the low favorability, while the lack of any known occurrences of metallic minerals in the immediate area is the reason for the lack of

confidence in this classification.

b. Uranium and Thorium

WSA NV 030-525A

U1-2B. This land classification indicating low favorability with low confidence for uranium covers all of WSA NV 030-525A and most of the central part of the GRA. The area is covered by Mesozoic metasediments and metavolcanics which have been intruded by Cretaceous granitic rocks, and Tertiary andesites and rhyolite tuffs. The area has low favorability for fracture-filled uranium deposits in metasediments, volcanics or granitic intrusive rocks. An occurrence of this type is located just south of the WSA in Cretaceous granite. Tertiary rhyolite tuffs or Cretaceous granitic rocks in the area are a possible source of uranium which could have been mobilized by ground water and redeposited in fractures in the volcanic sedimentary or intrusive rocks. Uranium could also have been deposited along or near intrusive contacts during emplacement of Cretaceous intrusions.

The area has low favorability with very low confidence for thorium in pegmatites which often occur with granitic intrusives.

U2-2B. This land classification indicating low favorability for uranium with low confidence covers areas in the southwestern, north-central and eastern parts of the GRA. These areas are covered by Tertiary-Quaternary alluvial deposits, and have low favorability for epigenetic sandstone-type uranium deposits. Uranium, leached from rhyolitic tuffs or granite by ground water, may have been deposited in reduced areas in permeable alluvium adjacent to the mountain ranges.

The area has low favorability with very low confidence for thorium-bearing monazite placer deposits in the alluvium. Small concentrations of monazite in alluvium may occur in basins adjacent to outcrops of Cretaceous granitic intrusives, assuming that thorium-bearing pegmatites are present with the intrusives.

c. Nonmetallic Minerals

WSA NV 030-525A

N1-2B. This classification area covers the entire WSA. No nonmetallic mineral occurrences are reported anywhere in or near the WSA. However, any mineral material can become an economic nonmetallic mineral if someone can develop an application that takes advantage of the

material's chemical or physical characteristics. This is the reason for the low favorability and low confidence in the classification.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 030-525A

OG1-1D. This WSA is essentially entirely underlain by a large Cretaceous granitic intrusive, partially capped by metasedimentary and metavolcanic units of Jurassic/Triassic age. A favorable geologic section for the generation or accumulation of oil and gas does not exist.

b. Geothermal

WSA 030-525A

G1-4D. The whole faulted mountain front of the WSA is contiguous with thermal deposits located to the north and south. Similar deposits probably exist at shallow depths within this portion of the WSA as well.

G2-2A. This portion of the WSA is faulted in part also, but the geologic environment is definitely not as favorable. The presence of thermal waters at Doud Springs is evidence that the WSA may be prospective in the more mountainous areas as well.

c. Sodium and Potassium

S1-1D. There is no indication of sodium and potassium resources in the WSA, and no geological reason to expect any. Therefore the entire WSA is classified as having no known potential for sodium and potassium, with a high level of confidence. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been considered in connection with nonmetallic minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. The San Juan-El Capitan mine should be reconnoitered to be sure that it really is where MILS places it. No other sources mention a mine of this name in the GRA, and none indicate any diggings at all where the San Juan-El Capitan is supposed to be. MILS locations have a deplorable tendency to be erroneous.

2. The vicinity of the Mountain Gold property should be examined, to determine if the veins that are reported represent a larger area of mineralization.

3. The WSA in general should be geologically mapped at a reconnaissance level of detail to see if there are areas of sulfide-bearing felsite beyond the area that Dixon (1971) mapped. If any are found, they should be chip sampled for geochemical analysis. Stream sediment sampling may serve a similar purpose, but the sample sites will have to be carefully chosen to avoid contamination from known mineralized areas.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

American Bureau of Metal Statistics Inc., 1982, Non-ferrous metal data -- 1981, Port City Press, New York, New York, pp. 133-134.

Axelrod, D. I., 1956, Mio-Pliocene floras from west-central Nevada: California Univer. Pubs. Geol. Sci., v. 33, pp. 1-322.

Dixon, R. L., 1971, The geology and ore deposits of the Red Canyon mining district, Douglas County, Nevada: M. S. thesis, University of Nevada Reno. Map at scale of 1:6,000, only detailed geology in the WSA. Good demonstration of the complexity of the geology, as compared to the simple geology implied by Moore (1969).

Garside, L. J., 1973, Radioactive mineral occurrences in Nevada: Nevada Bur. of Mines and Geol. Bull. 81.

Garside, L. J. and Schilling, J. H., 1979, Thermal waters of Nevada: Nevada Bur. of Mines and Geol. Bull. 91.

Garside, L. J., Weimer, B. S. and Lutsey, I. A., 1977, Oil and gas developments in Nevada, 1968-1976: Nevada Bur. Mines and Geol. Rept. 29.

Hill, J. M., 1915, Some mining districts in northeastern California and northwestern Nevada: U. S. Geol. Survey Bull. 594. Geological map is generalized, property locations are good; brief property descriptions.

Kirk, William S., 1980a, Thorium in Mineral Facts and Problems, 1980 ed., U. S. Bur. of Mines, Bull. 671, pp. 937-945.

Kirk, William S., 1980b, Thorium in Mineral Yearbook, vol. I, Metals and Minerals, U. S. Bur. of Mines, pp. 821-826.

Kirk, William S., 1982, Thorium in Mineral Commodity Summaries - 1982, U. S. Bureau of Mines, pp. 160-161.

Koenig, J. B., 1963, Geologic map of California, Walker Lake: California Div. of Mines and Geol.

Lintz, J. L., Jr., 1957, Nevada oil and gas drilling data, 1906-1953: Nevada Bur. Mines Bull. 52.

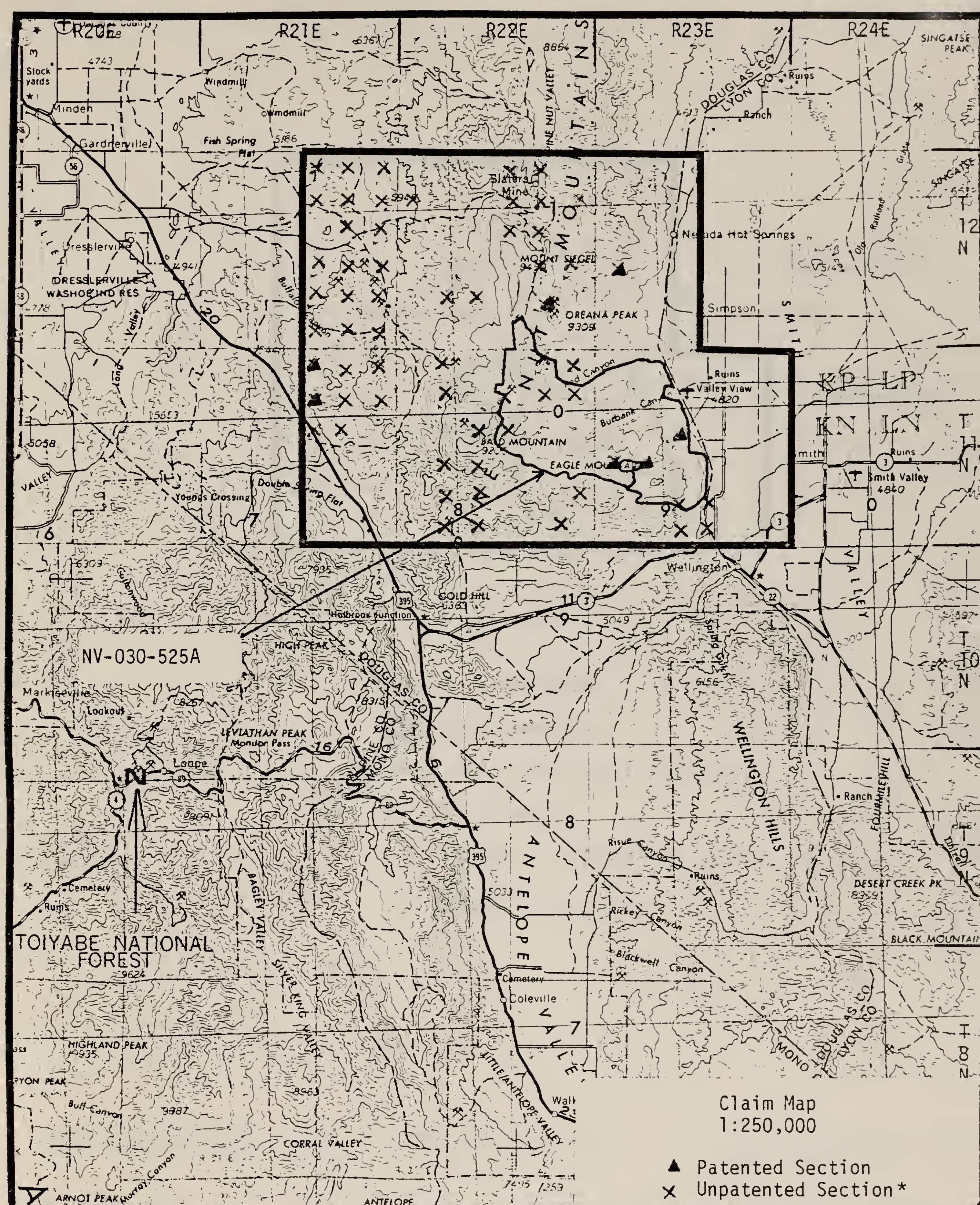
Moore, J. G., 1969, Geology and mineral deposits of Lyon, Douglas and Ormsby Counties, Nevada: Nevada Bur. of Mines and Geol. Bull. 75. Best available description of geology of the GRA.

Nevada Bureau of Mines and Geology Oil and Gas Files, 1982.

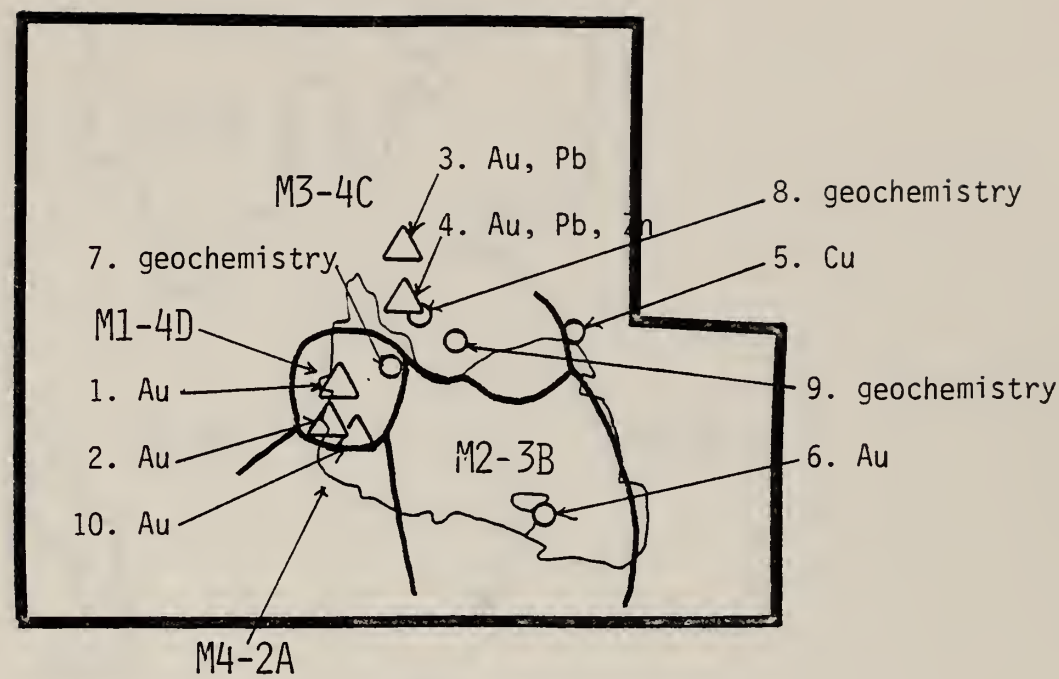
Noble, D. C., 1962, Mesozoic geology of the southern Pine Nut Range, Douglas County, Nevada: Ph.D. thesis, Stanford Univ.

Schilling, J. H. and Garside, L. J., 1968, Oil and gas developments in Nevada 1953-1967: Nevada Bur. Mines and Geol. Rept. 18.

Overton, T. D., 1947, Mineral resources of Douglas, Ormsby, and Washoe Counties: Nevada Univ. Bull., v. 41, no. 9, Geol. and Min. ser. no. 46.



*X denotes one or more claims per section



EXPLANATION

△ Mine, commodity

▬ Land Classification Boundary

—— WSA Boundary

1. Reference location (see text)

○ Occurrence, commodity

Land Classification - Mineral Occurrence Map/Metallics

Burbank Canyon GRA NV-10
Scale 1:250,000

EXPLANATION

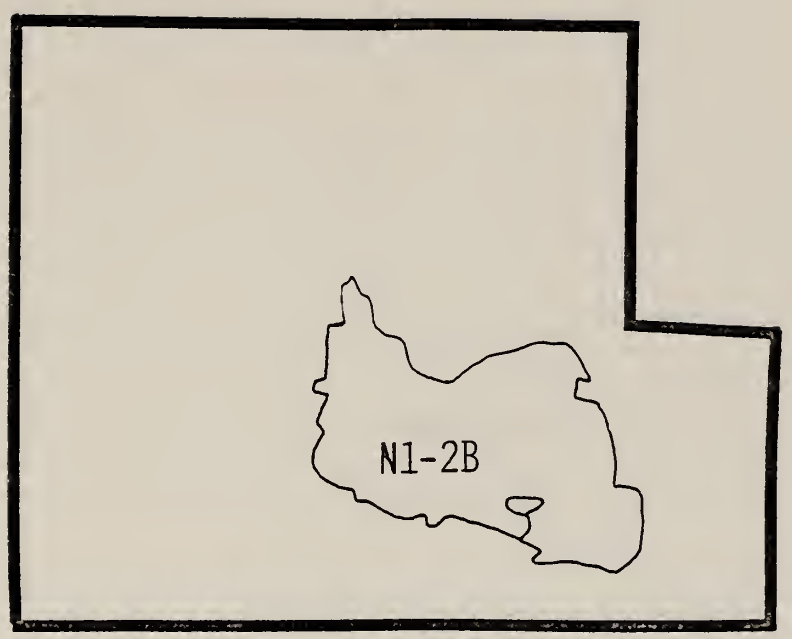
● Uranium Occurrence

▬ Land Classification Boundary

— WSA Boundary

Land Classification - Mineral Occurrence Map/Uranium

Burbank Canyon GRA NV-10
Scale 1:250,000



EXPLANATION

—— WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Nonmetallics

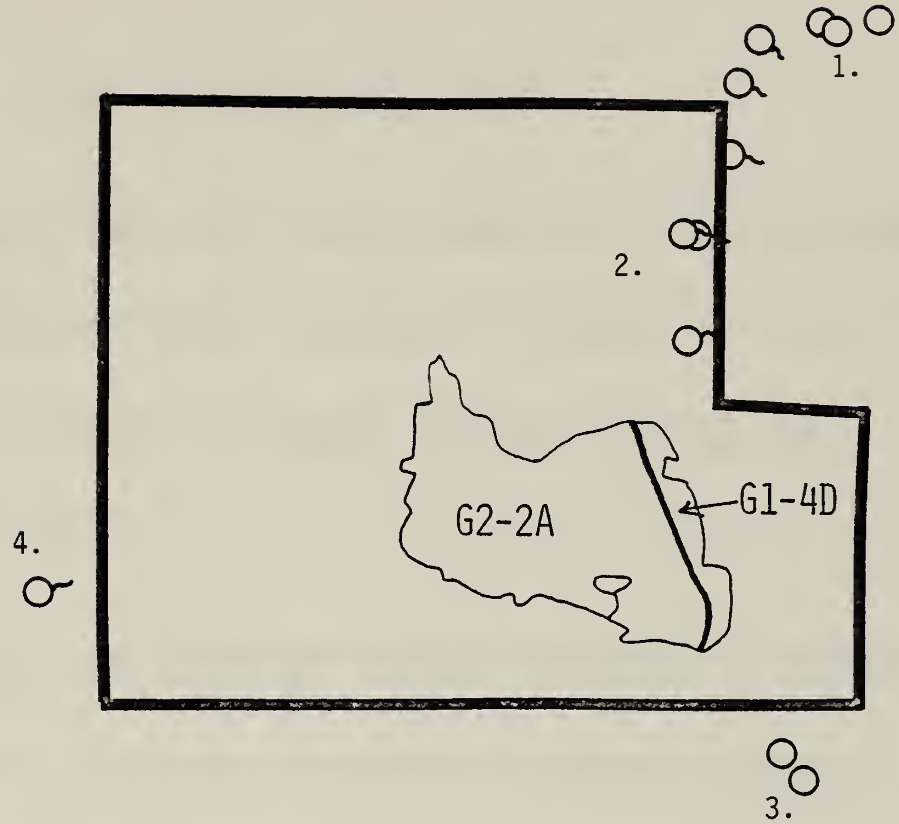
Burbank Canyon GRA NV-10
Scale 1:250,000

EXPLANATION

—— WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Oil and Gas

Burbank Canyon GRA NV-10
Scale 1:250,000



EXPLANATION

Thermal Well

Thermal Spring

1. Reference location (see text)

WSA Boundary

Land Classification Boundary

Land Classification - Mineral Occurrence Map/Geothermal

Burbank Canyon GRA NV-10
Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [4]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene; and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970